# CBSE Class 10 Science
# NCERT Solution

# Science Chapter 13 - Magnetic Effects of Electric Current

## In text Questions

**Page Number: 224**

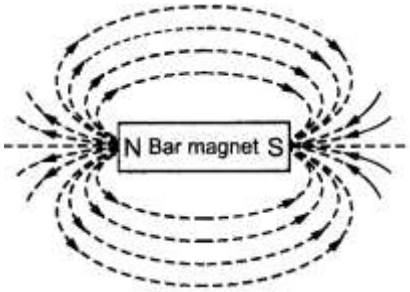
### Question 1:-Why does a compass needle get deflected when brought near a bar magnet?

Answer:
The magnetic field of the magnet exerts force on both the poles of the compass needle. The forces experienced by the two poles are equal and opposite. These two forces form a couple which deflects the compass needle.

**Page Number: 228**

### Question 1:-Draw magnetic field lines around a bar magnet.

**Answer:**




## Question 2:-List the properties of magnetic lines of force.

**Answer:**
Properties of magnetic lines of force :

- The magnetic field lines originate from the north pole of a magnet and end at its south pole.
- The magnetic field lines become closer to each other near the poles of a magnet but they are widely separated at other places.
- Two magnetic field lines do not intersect one another.

### Question 3:-Why don't two magnetic lines of force intersect each other?

**Answer:**
This is due to the fact that the resultant force on a north pole at any point can be only in one

direction. But if the two magnetic field lines intersect one another, then the resultant force on North Pole placed at the point of intersection will be along two directions, which is not possible.

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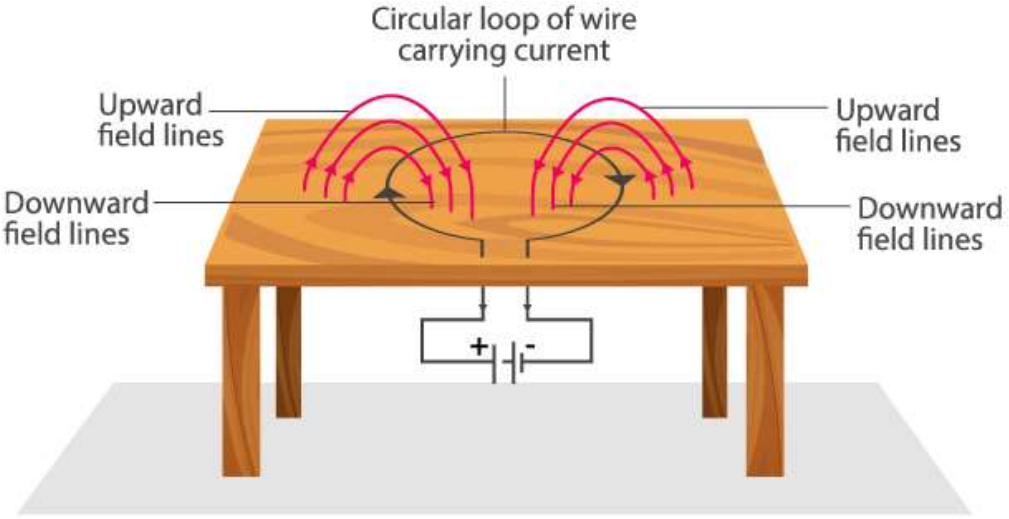
## Question 1:-Consider a circular loop of wire lying on the plane of the table. Let the current pass through the loop clockwise. Apply the right hand rule to find out the direction of the magnetic field inside and outside the loop.

**Answer:**



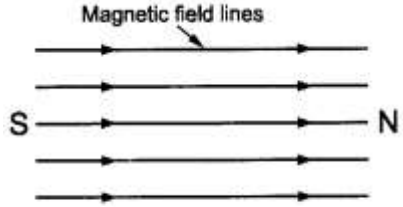

For the downward direction of the current, the direction of the magnetic field will be as if emerging from the table outside the loop and merging with the table inside the loop. Similarly, for current flowing in an upward direction, the direction of the magnetic field will be as if they are emerging from the table outside the loop and merging with the table inside the loop, as shown in the figure.

## Question 2:-The magnetic field in a given region is uniform. Draw a diagram to represent it.

**Answer:**

A uniform magnetic field in a region is represented by drawing parallel straight lines, ail pointing in the same direction.

For example, the uniform magnetic field which exists inside a current-carrying solenoid can be represented by parallel straight lines pointing from its S-pole to N-pole (as shown in figure).




**The uniform magnetic field inside a current-carrying solenoid**

**Question 3:-Choose the correct option.**
**The magnetic field inside a long straight solenoid-carrying current**
**(i) is zero**
**(ii) decreases as we move towards its end**
**(iii) increases as we move towards its end**
**(iv) is the same at all points**
**Answer:**
(iv) Is the same at all points.

**Page Number: 231 – 232**

**Question 1:-Which of the following property of a proton can change while it moves freely in a magnetic field. (There may be more than one correct answer.)**
**(i) Mass**
**(ii) Speed**
**(iii) Velocity**
**(iv) Momentum**
**Answer:**
The correct options are (iii) velocity, (iv) momentum.
When a proton enters the region of magnetic field, it experiences magnetic force. Due to which the path of the proton becomes circular. As a result, the velocity and the momentum change.

**Question 2:-In Activity 13.7 how do we think the displacement of rod AB will be affected if (i) current in rod AB is increased (ii) a stronger horse-shoe magnet is used; and (iii) length of the rod AB is increased?**
**Answer:**
(i) When the current in the rod AB is increased, force exerted on the conductor increases, so the displacement of the rod increases.
(ii) When a stronger horse-shoe magnet is used, the magnitude of the magnetic field increases. This increases the force exerted on the rod and the displacement of the rod.
(iii) When the length of the rod AB is increased, force exerted on the conductor increases, so the displacement of the rod increases.

**Question 3:-A positively-charged particle (alpha particle) projected towards west is deflected towards north by a magnetic field.**
**The direction of magnetic field is:**
**(i) towards south**
**(ii) towards east**
**(iii) downward**
**(iv) upward**
**Answer:**
(iv) Upward.
Here, the positively charged alpha particles are moving towards west, so the direction of current is towards east. The deflection is towards north, so the force is towards north, so, we are given that
(i) direction of current is towards west
(ii) direction of force is towards north.
Let us now hold the forefinger, middle finger and thumb of our left-hand at right angles to one

another. Adjust the hand in such a way that our mid finger points towards west (in the direction of current) and thumb points towards north (in the direction of force). Now, if we look at our forefinger, it will be pointing upward. Because the direction of forefinger gives the direction of magnetic field, therefore, the magnetic field is in the upward direction.

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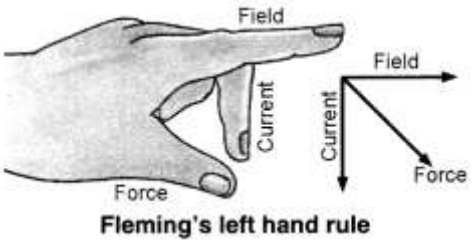
## Question 1:-State Fleming's left hand rule.

**Answer:**

Fleming's left hand rule : Stretch the first finger, the middle finger and the thumb of your left hand mutually perpendicular to each other in such a way that the first finger represents the direction of the magnetic field, the middle finger represents the direction of the current in the conductor, then the thumb will represent the direction of motion of the conductor.



Fleming's left hand rule

## Question 2:-What is the principle of an electric motor?

**Answer:**

A motor works on the principle of magnetic effect of current. When a rectangular coil is placed in a magnetic field and current is passed through it, a force acts on the coil which rotates it continuously. When the coil rotates, the shaft attached to it also rotates. In this way the electrical energy supplied to the motor is converted into the mechanical energy of rotation.

## Question 3:-What is the role of the split ring in an electric motor?

**Answer:**

The split ring reverses the direction of current in the armature coil after every half rotation, i.e., it acts as a commutator. The reversed current reverses the direction of the forces acting on the two arms of the armature after every half rotation. This allows the armature coil to rotate continuously in the same direction.

**Page Number: 236**

## Question 1:-Explain different ways to induce current in a coil.

**Answer:**

Different ways to induce current in a coil are :

1. moving a magnet towards or away from the coil or vice-versa, and
2. Changing current in the neighboring coil.

**Page Number: 237**

## Question 1:-State the principle of an electric generator.

**Answer:**

The electric generator works on the principle that when a straight conductor is moved in a magnetic field, then current is induced in the conductor.
In an electric generator, a rectangular coil is made to rotate rapidly in the magnetic field between the poles of a horse-shoe type magnet. When the coil rotates, it cuts the magnetic field lines due to which a current is produced in the coil.

## Question 2:-Name some sources of direct current.

**Answer:**
Some of the sources of direct current are dry cells, button cells, lead accumulators and DC generator.

## Question 3:-Which sources produce alternating current?

**Answer:**
Alternating current is produced by AC generators of nuclear power plants, thermal power plants, hydroelectric power stations, etc.

## Question 4:-Choose the correct option: A rectangular coil of copper wires is rotated in a magnetic field. The direction of the induced current changes once in each:

**(i) two revolution**
**(ii) one revolution**
**(iii) half revolution**
**(iv) one-fourth revolution**

**Answer:**
(iii) Half revolution.
When a rectangular coil is rotated in magnetic field, the direction of the induced current changes once in half revolution. As a result, the direction of the current in the coil remains the same.

**Page Number: 238**

## Question 1:-Name two safety measures commonly used in electric circuits and appliances.

**Answer:**
(i) Earthing and
(ii) Electric fuse.
The safety measured commonly used in electric circuits are as follows:

1. **Fuse**

Each circuit should be connected to a fuse because a fuse prevents the flow of excessive current through the circuit. When the current in the circuit exceeds the maximum limit of the fuse element, the fuse melts to stop the flow of current protecting the appliance connected to circuit.

1. **Earthing**

Earthing protects the user from electric shocks. Any leakage of current in an appliance is transferred to the ground by earthing and the people using the appliance is prevented from getting electrocuted.

## Question 2:-An electric oven of 2 kW power rating is operated in a domestic electric circuit (220 V) that has a current rating of 5 A. What result do you

**expect? Explain.**
**Answer:**
The electric oven draws a current given by

$$I = \frac{P}{V} = \frac{2\ kW}{220\ V} = \frac{2000\ W}{220\ V} = \mathbf{9.09\ A}$$

Thus the electric oven draws current much more than the current rating 5 A. That is the circuit is overloaded. Due to excessive current, the fuse wire will blow and the circuit will break.

**Question 3:-**
**What precautions should be taken to avoid the overloading of domestic electric circuits?**
To avoid the overloading of domestic electric circuits, the following precautions should be taken :
(i) The wires used in the circuit must be coated with good insulating materials like PVC, etc.
(ii) The circuit must be divided into different sections and a safety fuse must be used in each section.
(iii) High power appliances like air-conditioner, refrigerator, a water heater, etc. should not be used simultaneously.

## NCERT Solutions for Class 10 Science

# Chapter 13

## Textbook Chapter End Questions

**Question 1:-Which of the following correctly describes the magnetic field near a long straight wire?**
**(i) the field consists of straight lines perpendicular to the wire**
**(ii) the field consists of straight lines parallel to the wire**
**(iii) the field consists of radial lines originating from the wire**
**(iv) the field consists of concentric circles centered on the wire**
**Answer:**
(iv) The field consists of concentric circles centered on the wire

**Question 2:-The phenomenon of electromagnetic induction is**
**(i) the process of charging a body**
**(ii) the process of generating magnetic field due to a current passing through a coil**
**(iii) producing induced current in a coil due to relative motion between a magnet and the coil**
**(iv) the process of rotating a coil of an electric motor**
**Answer:**
(iii) Producing induced current in a coil due to relative motion between a magnet and the coil

**Question 3:-The device used for producing electric current is called a**
**(i) generator**
**(ii) galvanometer**
**(iii) ammeter**

## (iv) motor

**Answer:**

(i) Generator.

The device used for producing electric current is known as generator. Generator converts mechanical energy to electric energy.

## Question 4:-The essential difference between an AC generator and a DC generator is that

## (i) AC generator has an electromagnet while a DC generator has permanent magnet

## (ii) DC generator will generate a higher voltage

## (iii) AC generator will generate a higher voltage

## (iv) AC generator has slip rings while the DC generator has a commutator

**Answer:**

(iv) AC generator has slip rings while the DC generator has a commutator

AC generators have two rings known as the slip rings while DC generators have two half rings known as the commutator. This is main difference between AC generator and DC generator.

## Question 5:-At the time of short circuit, the current in the circuit

## (i) reduces substantially

## (ii) does not change

## (iii) increases heavily

## (iv) varies continuously

**Answer:**

(iii) Increases heavily.

When two naked wires in the circuit come in contact with each other, the amount of current flowing in the circuit increase abruptly resulting in short circuit.

## Question 6:-State whether the following statements are true or false.

## (i) An electric motor converts mechanical energy into electrical energy.

## (ii) An electric generator works on the principle of electromagnetic induction.

## (iii) The field at the center a long circular coil carrying current will be parallel straight lines.

## (iv) A wire with a green insulation is usually the live wire of an electric supply.

**Answer:**

(i) False

(ii) True

(iii) True

(iv) False.

a. False

An electric motor converts electrical energy into mechanical energy.

b. True

An electric generator is a device that generates electricity by rotating a coil in a magnetic field.

c. True

A long circular coil is a solenoid. The magnetic field lines inside a solenoid are parallel straight lines.

d. False

Live wires have red insulation cover while the earth wire has green insulation.

## Question 7:-List three sources of magnetic fields.

**Answer:**

Following are the methods of producing magnetic fields:

- By using a permanent magnet we can produce magnetic field and it can be visualized by spreading iron fillings on a white paper and keeping a magnet beneath the paper.
- A current carrying straight conductor produces magnetic field.
- Different types of conductors such as solenoid and circular loop can be used to see the presence of magnetic field.

## Question 8:-How docs a solenoid behave like a magnet? Can you determine the north and south poles of a current-carrying solenoid with the help of a bar magnet? Explain.

**Answer:**

A solenoid behaves like a magnet in the following ways.

- The magnetic field produced by a current carrying solenoid is very much similar to that of a bar magnet.
- Like a bar magnet, one end of the solenoid has N-polarity while the other end has S-polarity.

To determine the north and south poles, we bring N-pole of the bar magnet near one end of the solenoid. If there is an attraction, then that end of the solenoid has south polarity and the other has north polarity. If there is a repulsion, then that end of the solenoid has north polarity and the other end has south polarity because similar poles repel each other.

## Question 9:-When is the force experienced by a current-carrying conductor placed in a magnetic field largest?

**Answer:**

When the conductor carries current in a direction perpendicular to the direction of the magnetic field, the force experienced by the conductor is largest.

## Question 10:-Imagine that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally from back wall towards the front wall, is deflected by a strong magnetic field to your right side. What is the direction of magnetic field?

**Answer:**

Here the electron beam is moving from our back wall to the front wall, so the direction of current will be in the opposite direction, from front wall towards back wall or towards us. The direction of deflection (or force) is towards our right side.
We now know two things:

- direction of current is from front towards us, and
- Direction of force is towards our right side.

Let us now hold the forefinger, middle finger and thumb of our left hand at right angles to one another. We now adjust the hand in such a way that our centre finger points towards us (in the direction of current) and thumb points towards right side (in the direction of force). Now, if we look

at our forefinger, it will be pointing vertically downwards. Since the direction of forefinger gives the direction of magnetic field, therefore, the magnetic field is in the vertically downward direction.

## Question 11:-Draw a labelled diagram of an electric motor. Explain its principle and working. What is the function of a split ring in an electric motor?

**Answer:**

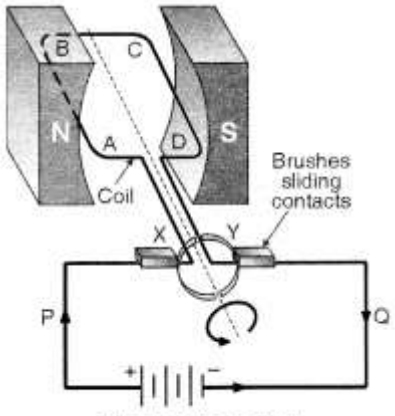
**Electric Motor :** The device used to convert electrical energy to mechanical energy is called Electric Motor. It is used in fans, machines, etc.

**Principle:** NCERT Solutions for Class 10 Science Chapter 13 Magnetic Effects of Electric Current Electric motor works on the principle of force experienced by a current carrying conductor in a magnetic field. The two forces in the opposite sides are equal and opposite. Since they act in different lines they bring rotational motion.

**Working of an electric motor:**

When current starts to flow, the coil ABCD is in horizontal position. The direction of current through armature coil has the direction from A to B in the arm AB and from C to D in the arm CD. The direction of force exerted on the coil can be found through Fleming's left hand law.

According to this law, it is found that the force exerted on the part AB, pushes the coil downwards. While the force exerted on the part CD pushes it upwards. In this way, these two forces being equal and opposite form a couple that rotates the coil in anticlockwise direction.



An electric motor

When the coil is in vertical position, the brushes X and Y would touch the center of the commutator and the current in the coil is stopped. Though current is stopped but the coil comes back in horizontal state due to momentum.

After half rotation, the polarity of the commutator also changes, because now Q makes contact with brush X and P with brush Y. Therefore, now the force exerts downwards on the arm AB and upwards on the arm CD and thus again a couple of forces is formed that rotates the coil in clockwise direction. This process is repeated again and again and the coil rotates till the current flows across it.

**Function of split ring:** Split ring in a motor acts as a commutator, i.e., it reverses the flow of current in the circuit due to which the direction of the forces acting on the arms also reverses.

## Question 12:-Name some devices in which electric motors are used.

**Answer:**

Electric motor is used in the appliances like electric fans, washing machine, mixers, grinders, blenders, computers, MP3 players, etc.

## Question 13:-A coil of insulated copper wire is connected to a galvanometer. What will happen if a bar magnet is (t) pushed into the coil (ii) withdrawn from inside the coil (iii) held stationary inside the coil?

**Answer:**

(i) As a bar magnet is pushed into the coil, a momentary deflection is observed in the galvanometer indicating the production of a momentary current in the coil.
(ii) When the bar magnet is withdrawn from the coil, the deflection of galvanometer is in opposite direction showing the production of an opposite current.
(iii) When the bar magnet is held stationary inside the coil, there is no deflection in galvanometer indicating that no current is produced in the coil.

## Question 14:-Two circular coils A and B are placed closed to each other. If the current in the coil A is changed, will some current be induced in the coil B? Give reason.

**Answer:**

Yes, some current will be induced in the coil B. When the current in coil A is changed, some current is induced in the coil B. Due to change in current in coil A, the magnetic field lines linked with coil A and with coil B get changed. This sets up induced current in coil B.

## Question 15:-State the rule to determine the direction of a (i) magnetic field produced around a straight conductor-carrying current (it) force experienced by a current-carrying straight conductor placed in a magnetic field which is perpendicular to it, and (in) current induced in a coil due to its rotation in a magnetic field.

**Answer:**

**(i) Right hand thumb rule :** If the current carrying conductor is held in the right hand such that the thumb points in the direction of the current, then the direction of the curl of the fingers will give the direction of the magnetic field.
**(ii) Fleming's left hand rule:** NCERT Solutions for Class 10 Science Chapter 13 Magnetic Effects of Electric Current Stretch the forefinger, the central finger and the thumb of the left hand mutually perpendicular to each other. If the forefinger points in the direction of the magnetic field, the middle finger in the direction of current, then the thumb points in the direction of force in the conductor.
**(iii) Fleming's right hand rule:** Stretch the thumb, forefinger and the central finger of the right hand mutually perpendicular to each other. If the forefinger points in the direction of magnetic field, thumb in the direction of motion of the conductor, then the middle finger points in the direction of current induced in the conductor.

## Question 16:-Explain the underlying principle and working of an electric generator by drawing a labelled diagram. What is the function of brushes?

**Answer:**

**Principle :** The electric generator is based on the principle of electromagnetic induction. When a coil is rotated with respect to a magnetic field, the number of magnetic field lines through the coil changes. Due to this a current is induced in the coil whose direction can be found by Fleming's right

hand rule.

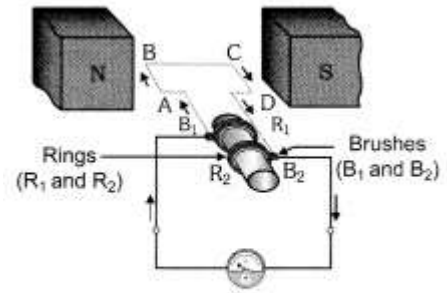


Illustration of the principle of electric generator

**Working:** When the armature coil ABCD rotates in a magnetic field produced by the permanent magnets, it cuts through the magnetic lines of force.
Due to the rotation of armature coil, the associated magnetic field changes and an induced electromagnetic force is produced in it. The direction of this induced electromotive force or current can be determined by using Fleming's right hand rule.
In first half cycle the current flows in one direction by brush $B_1$ and in second it flows in opposite direction by brush $B_2$. This process continues. So the current produced is alternating in nature.
**Functions of Brushes:** Brushes in contact with rings provide the current for external use.

## Question 17:-When does an electric short circuit occur?

**Answer:**
In a domestic circuit, short-circuit occurs when live and neutral wire come in direct contact with each other without any resistance. The resistance of the circuit becomes zero and excessive current starts to flow through it.

## Question 18:-What is the function of an earth wire? Why is it necessary to earth metallic appliances?

**Answer:**
Earth wire is a safety measure that provides a low resistance conducting path to the current. Sometimes due to excess heat or wear and tear, the live wire comes in direct contact with the metallic cover of the appliances, which can give an electric shock on touching them. To prevent from the shock the metallic part is connected to the earth through a three-pin plug due to which the current flows to the earth at the instant there is a short circuit.

It is necessary to earth metallic appliances because it ensures that if there is any current leakage in the metallic cover, the potential of the appliance becomes equal to that of the earth. The potential of the earth is zero. As a result, the person handling the appliance will not get an electric shock.